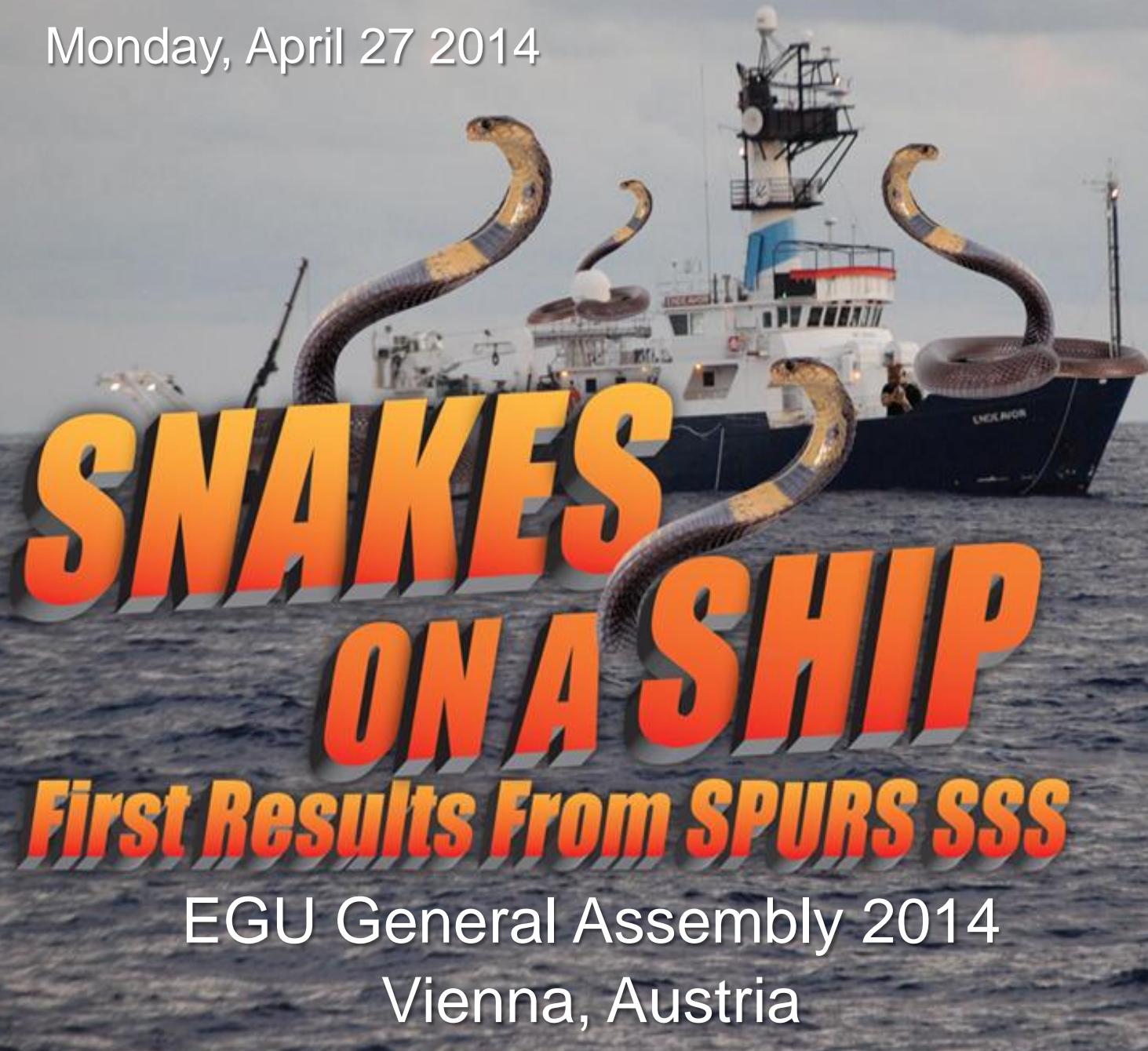


Monday, April 27 2014



Julian J  
Schanze<sup>1</sup>

Gary  
Lagerloef<sup>1</sup>

Raymond  
W Schmitt<sup>2</sup>

Benjamin A  
Hodges<sup>2</sup>

1



2



Funding:



# Sea Snake: A Brief History

- During SPURS I (September 2012):
  - Surface salinity enhancements ( $\Delta SSS$  0m-5m) up to 0.2 psu measured by Ecomapper AUVs & Wave Gliders
  - No surface samples could be taken to confirm measurements ('vessel stirring')
- This caused some controversy:
  - Suggestions that enhancements were just instrument errors
  - In collaboration with Gary Lagerloef (idea) and Ray Schmitt (funding and further ideas), I designed the 'SPURS Surface Salinity Sea Snake' to obtain verifiable surface measurements



# Development



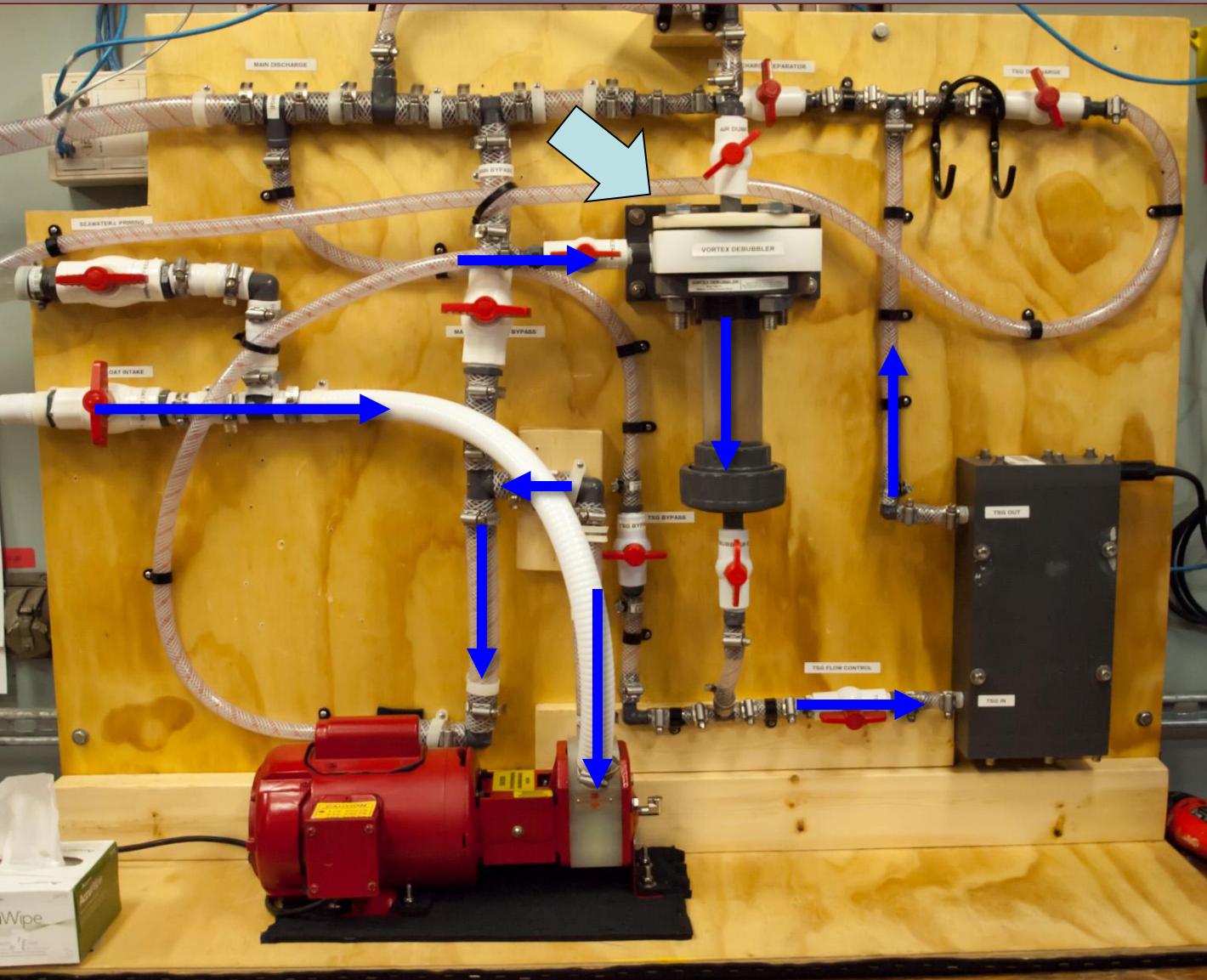
- ‘Sea Snake’ test bed
- Towed from same height as R/V Endeavor
- Several iterations
- Tests from 8-15 kt.

# Background



- Suction hose mounted on boom with halyard system
- Hose mostly outside bow wake
- Limitations on boom length – could be improved

# Background



- Revised ship-side apparatus
- Routing of hoses optimized for more effective de-bubbling ('two-stage')

# Background



- Removal of bubbles is crucial for accuracy
- Bottle samples and MicroTSG show excellent agreement

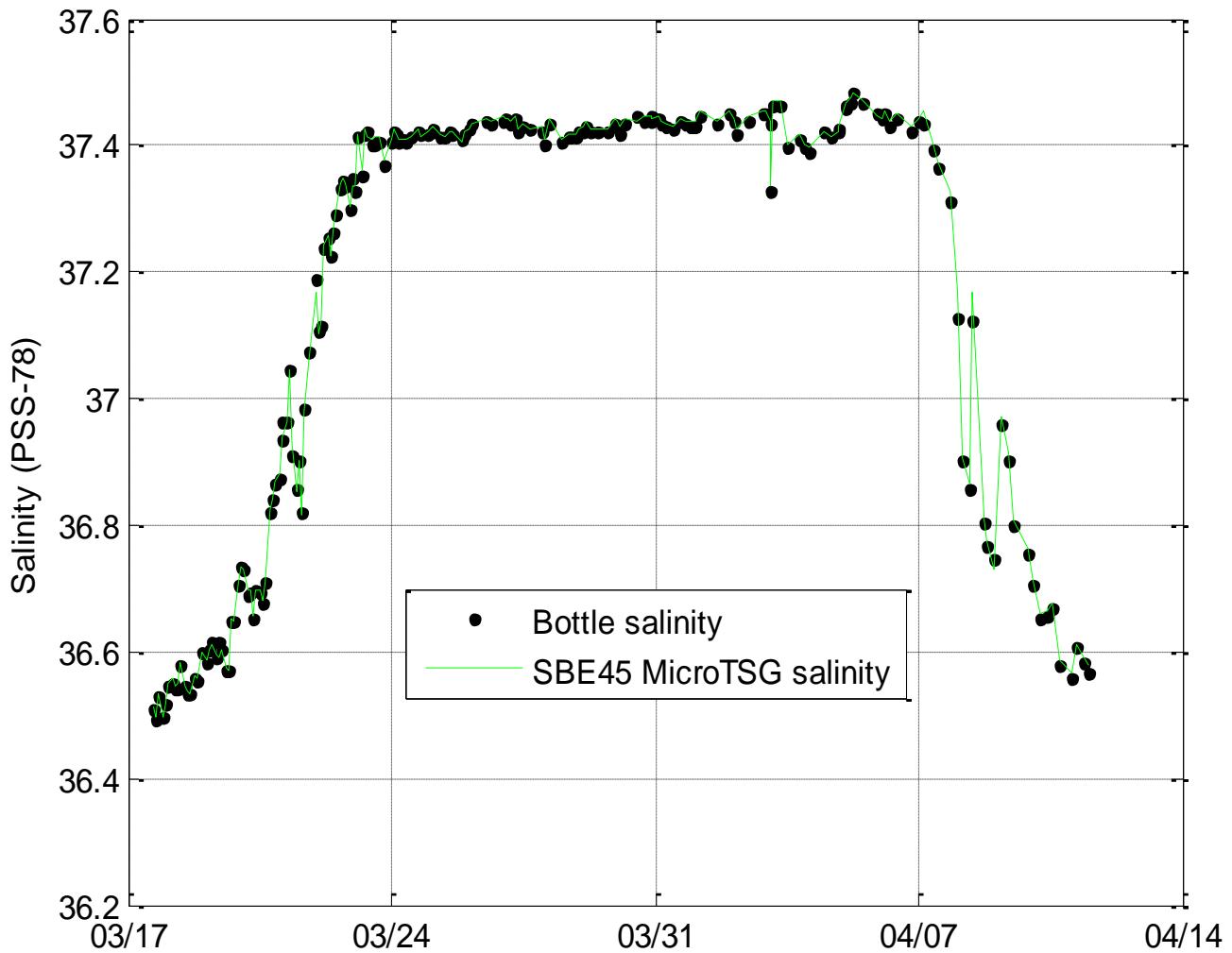
## II Results: SPURS 2 (March/April 2013)



- Excellent agreement between bottle samples and MicroTSG measurements
- Found salinity enhancement of 0.25 psu relative to shipboard (0.15 bottle verified)



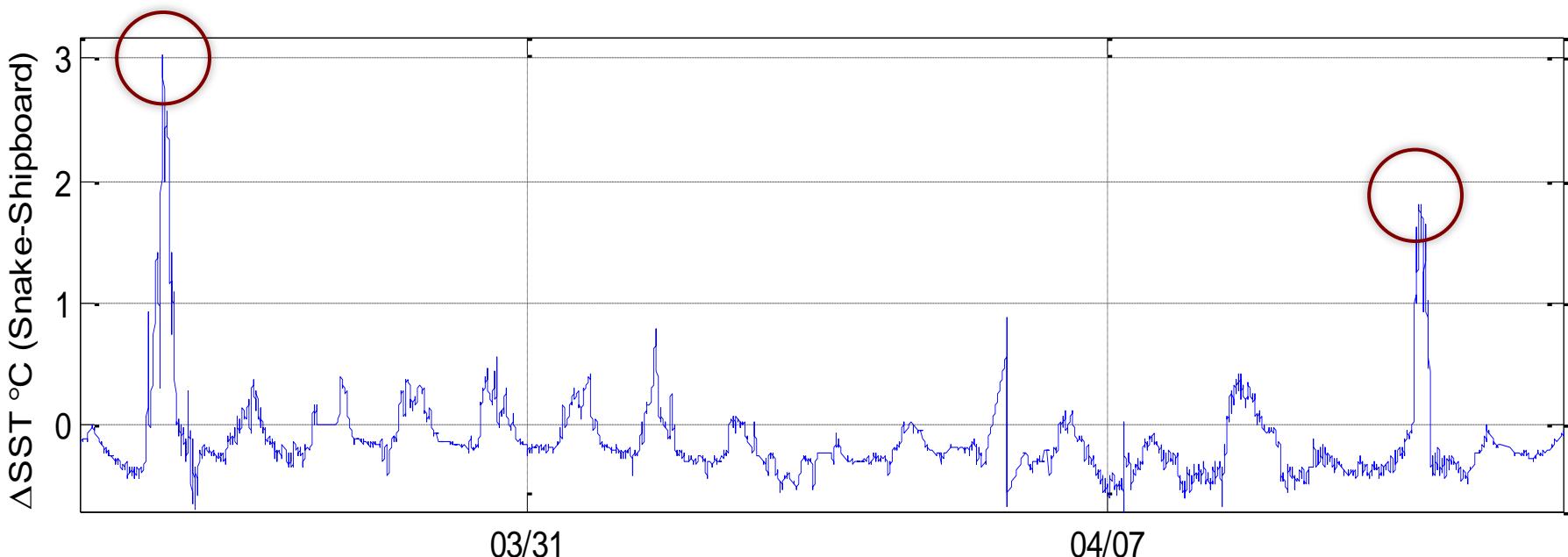
## II Results: SPURS 2 (March/April 2013)



- Shipboard MicroTSG validated using salinometer
- Note lack of diurnal salinity enhancements



## II Results: SPURS 2 (March/April 2013)



- $\Delta$ SST (0m-5m) shown here
- 2 major events: 3/26 and 4/10 with 3°C and 2°C, respectively
- Strong salinity enhancement on 3/26/2013
- Diurnal signal still visible on most days

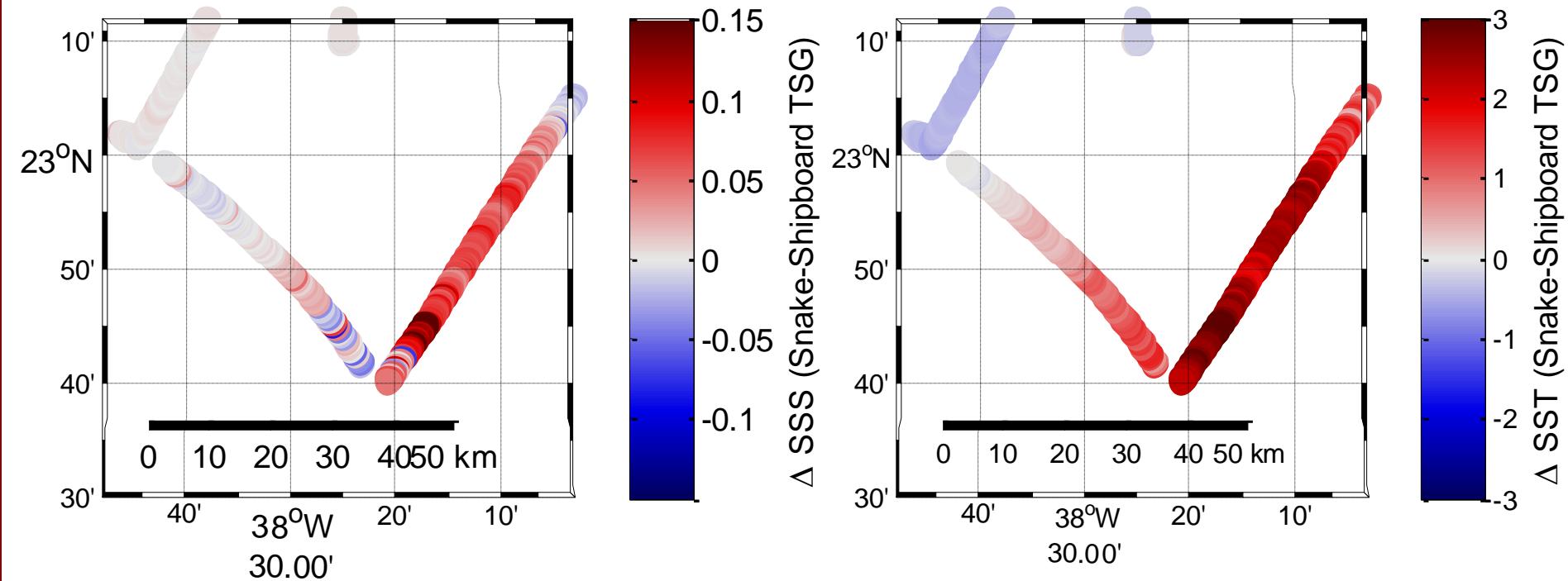
# Results: SPURS 2 (3/26/2013)



- Most interesting results during calm conditions (3/26 shown)
- Surface salinity increases of over 0.25 (0.15 verified) observed

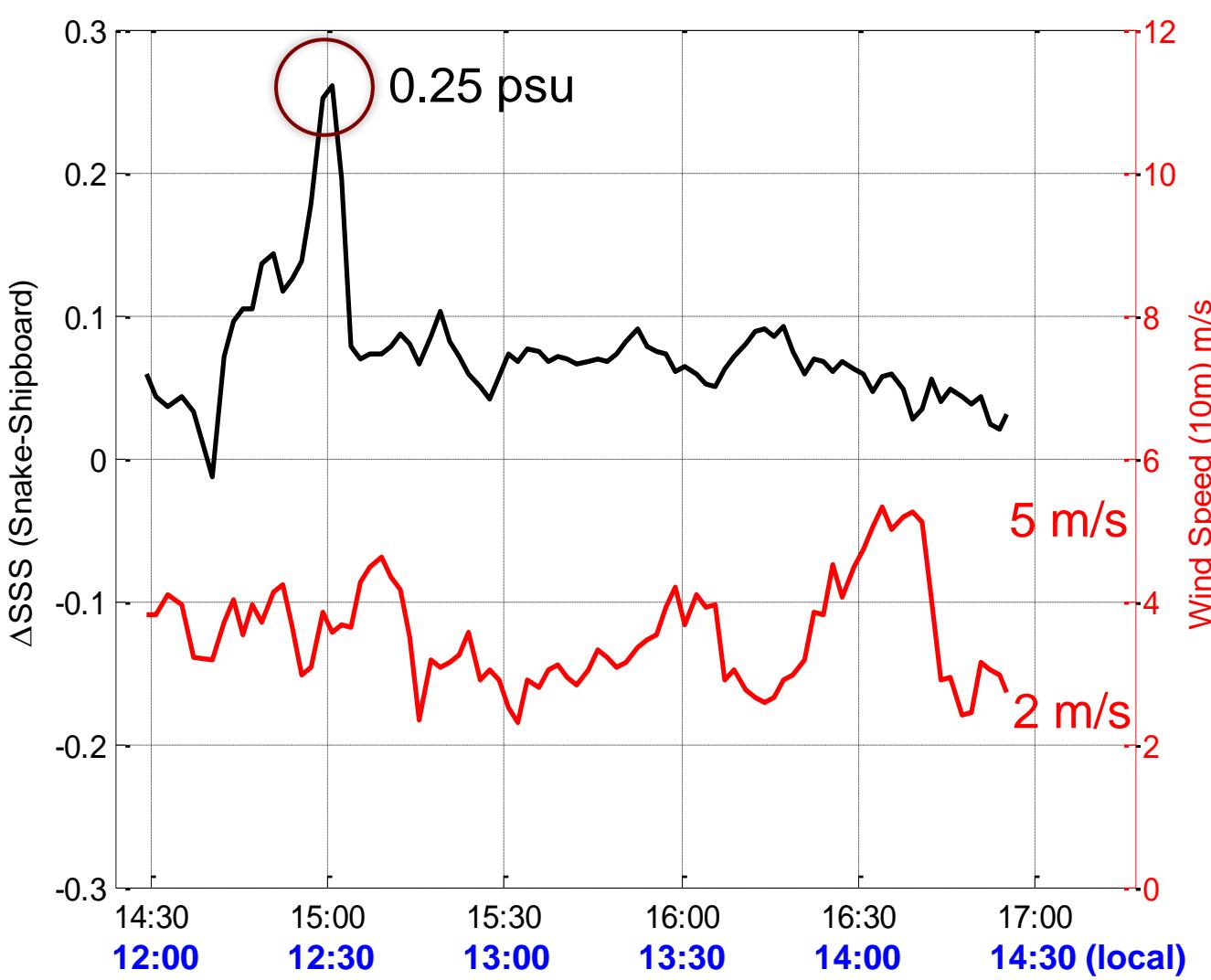


# Results: SPURS 2 (3/26/2013)



- Cruise track with color-coded  $\Delta SSS$  and  $\Delta SST$  (0-5m) shown
- Strongest SSS enhancement of the cruise (3/26/2013)
- Enhancement exceeding 3°C and 0.15 psu (verified)

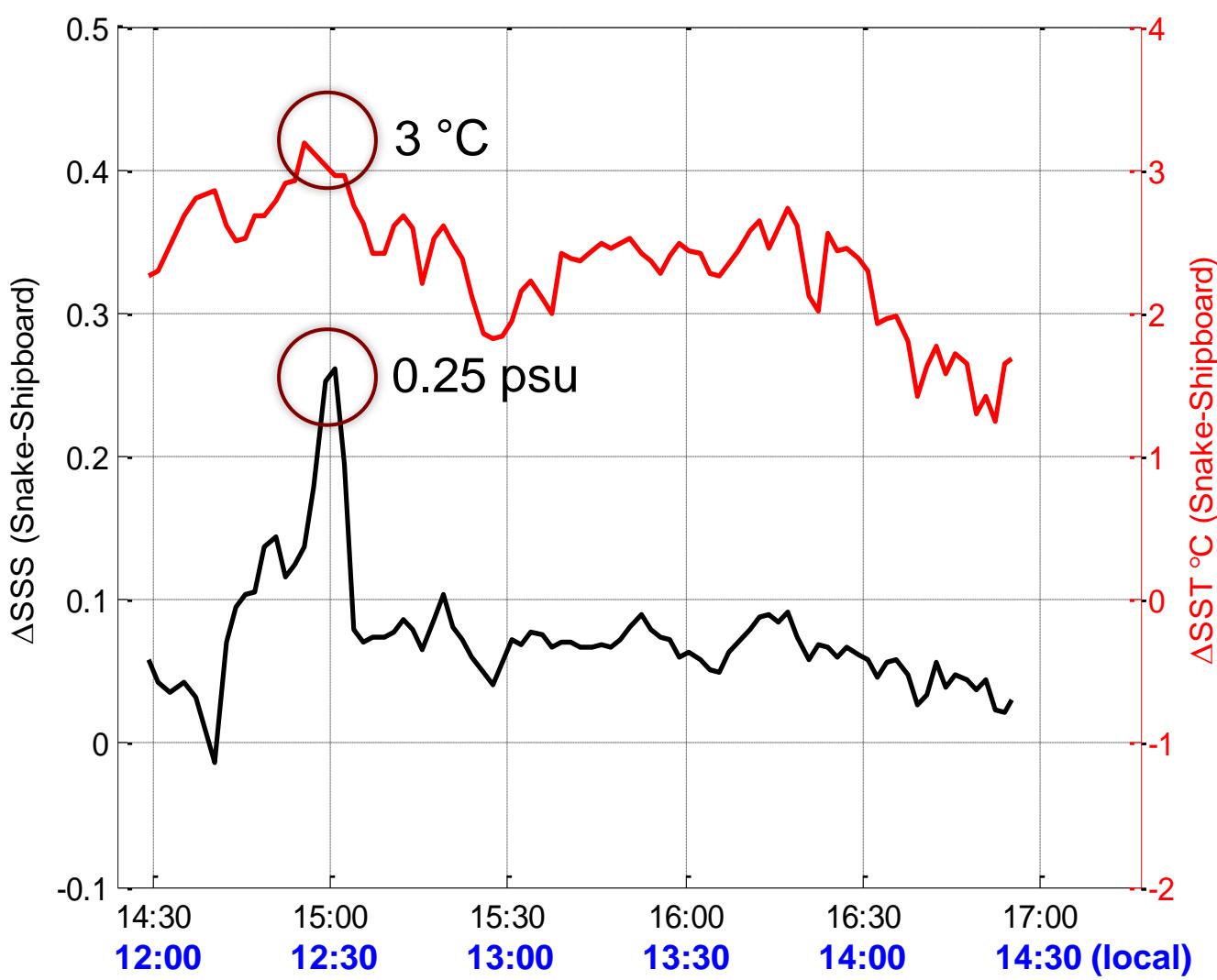
# Results: SPURS 2 (3/26/2013)



- SSS Enhancement event shown
- Maximum at 0.25 psu
- Wind speed in m/s in red (2-5 m/s)
- Time in UTC, local time shown in blue.

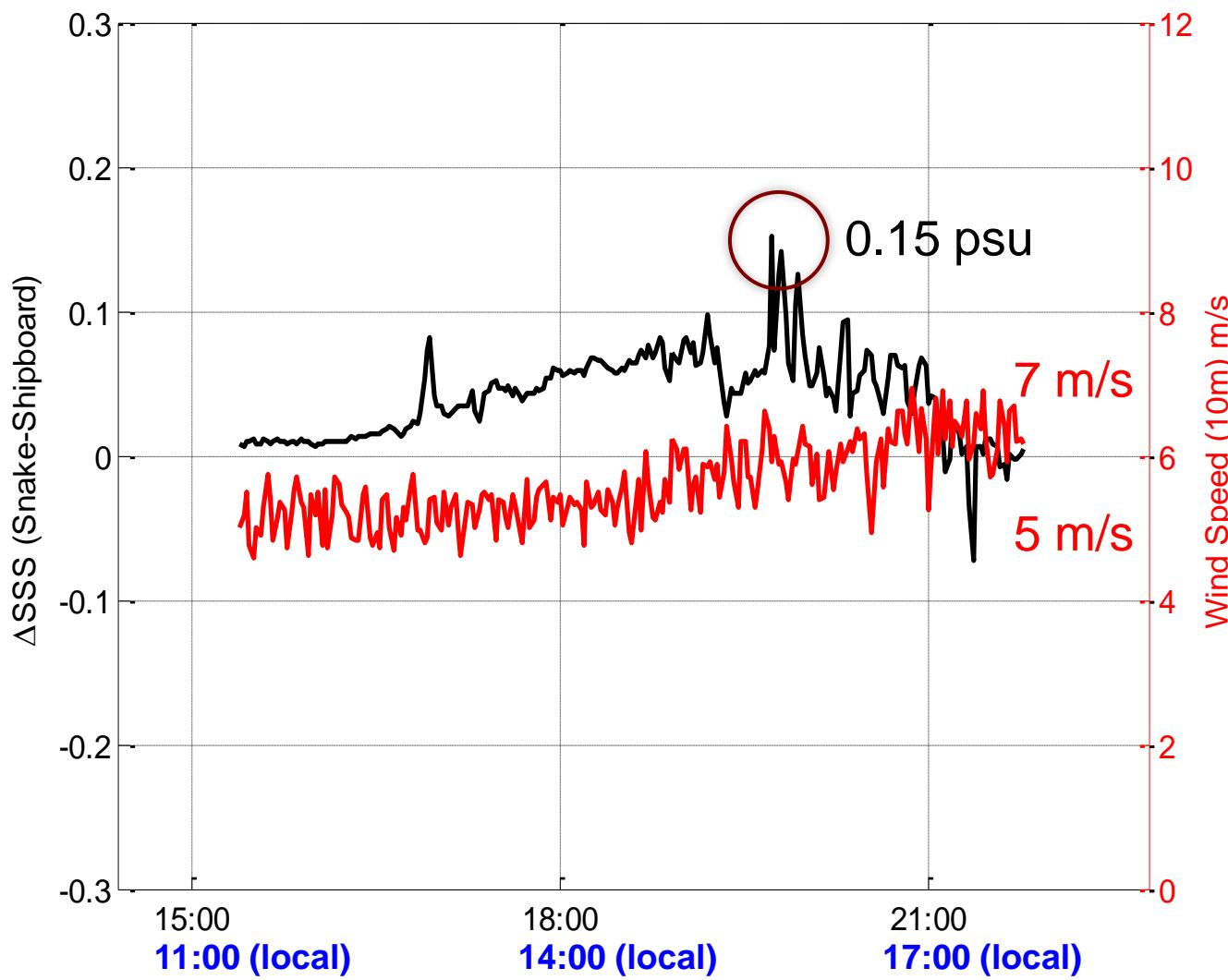


# Results: SPURS 2 (3/26/2013)



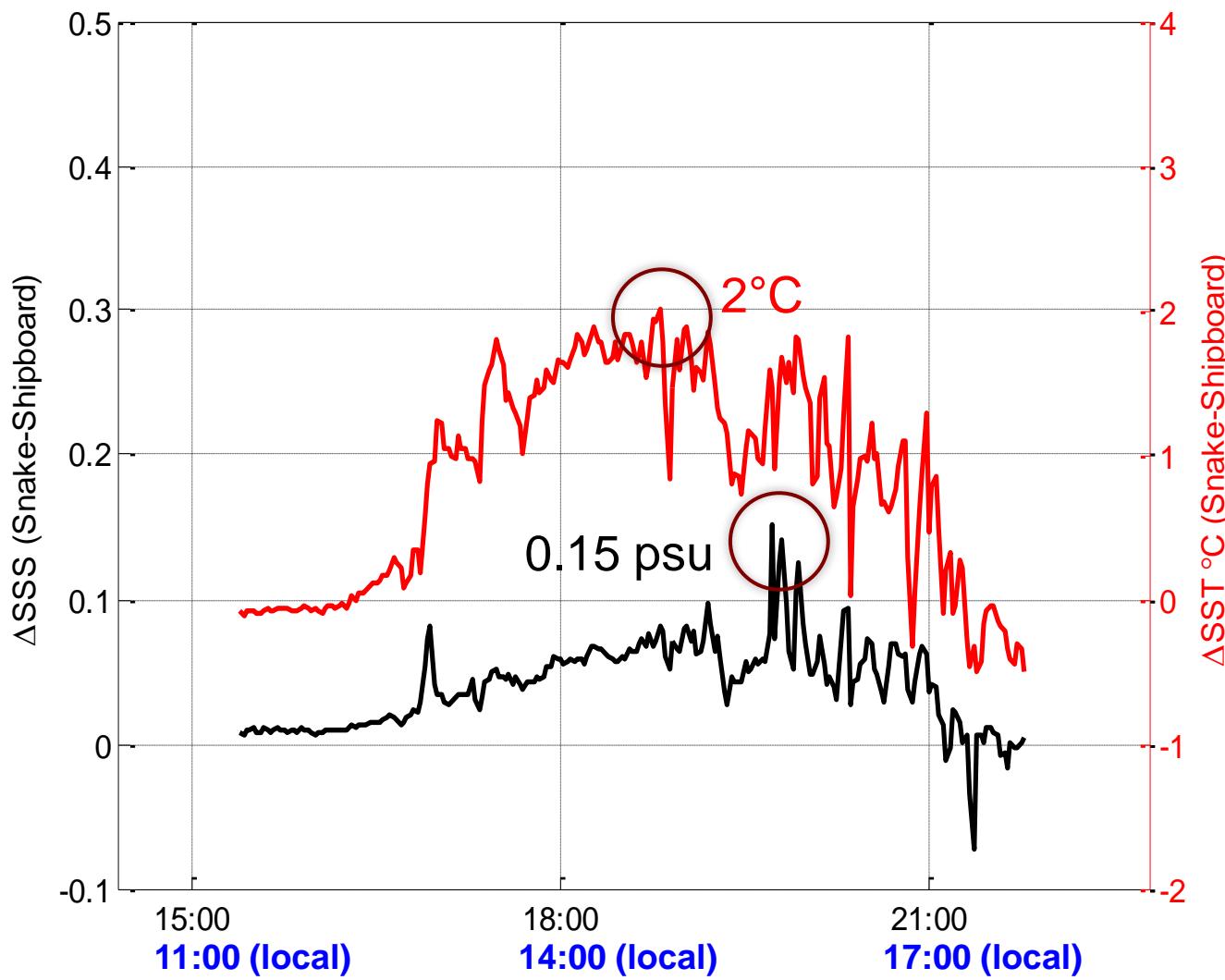
- Salinity enhancement (black)
- Temperature enhancement (red)
- Time in UTC, local time shown in blue
- SSS/SST often correlated

# Results: SPURS 2 (4/10/2013)



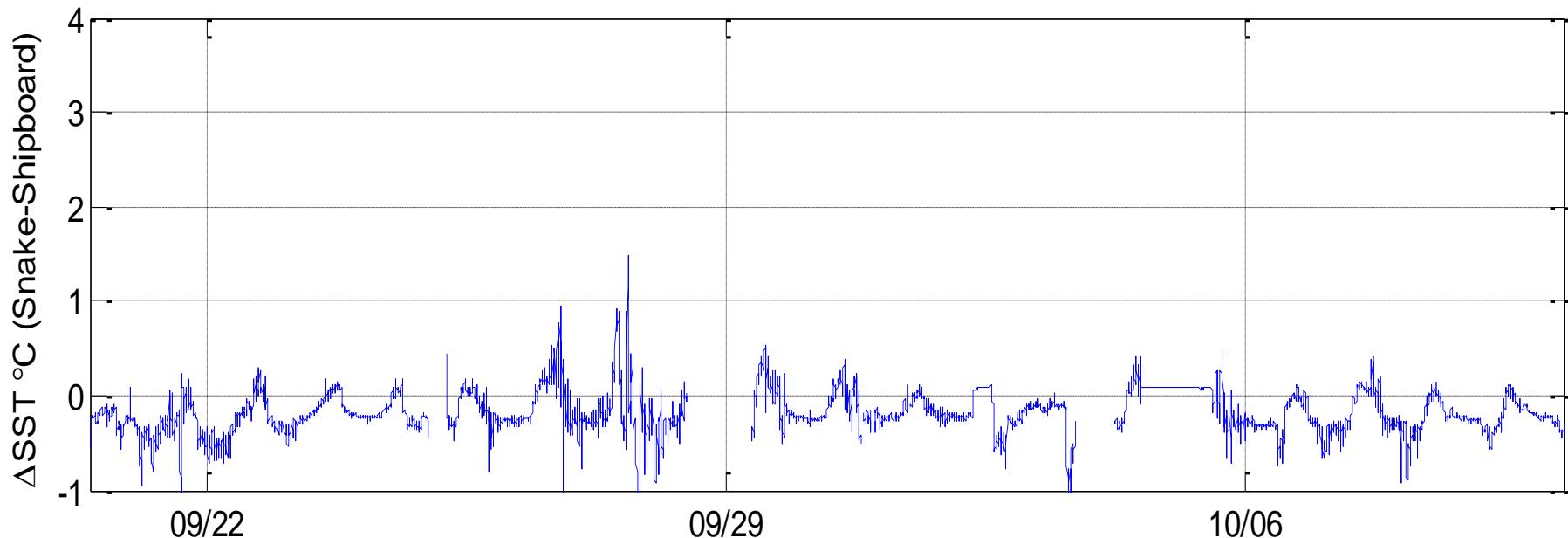
- Weaker enhancement event shown
- Wind speed in m/s in red (5-7 m/s)
- Time in UTC, Local time in blue
- ~100 km along-track shown

# Results: SPURS 2 (4/10/2013)



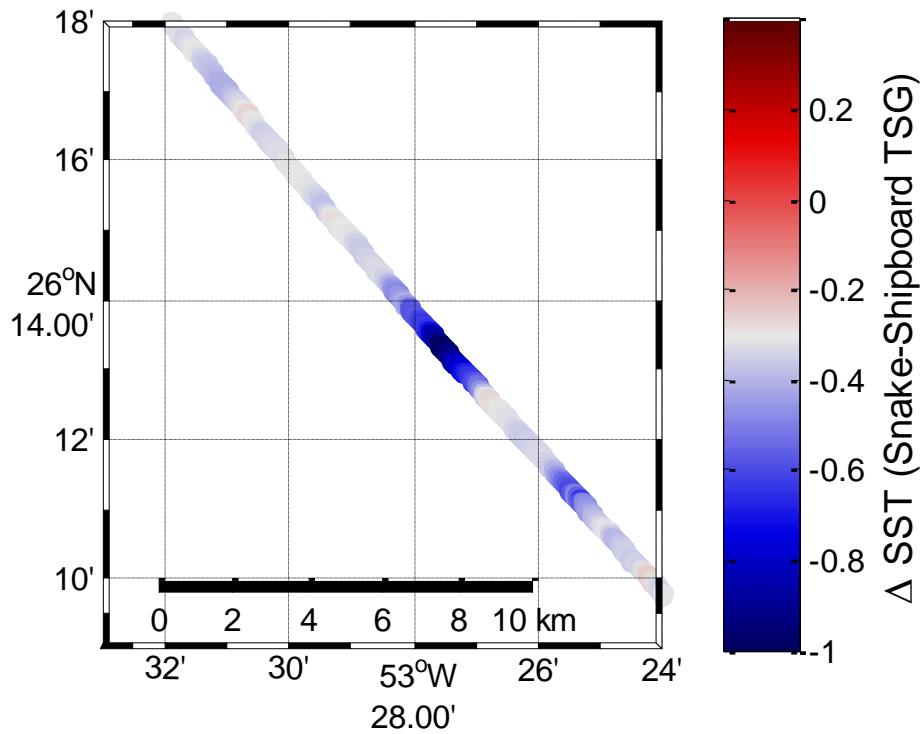
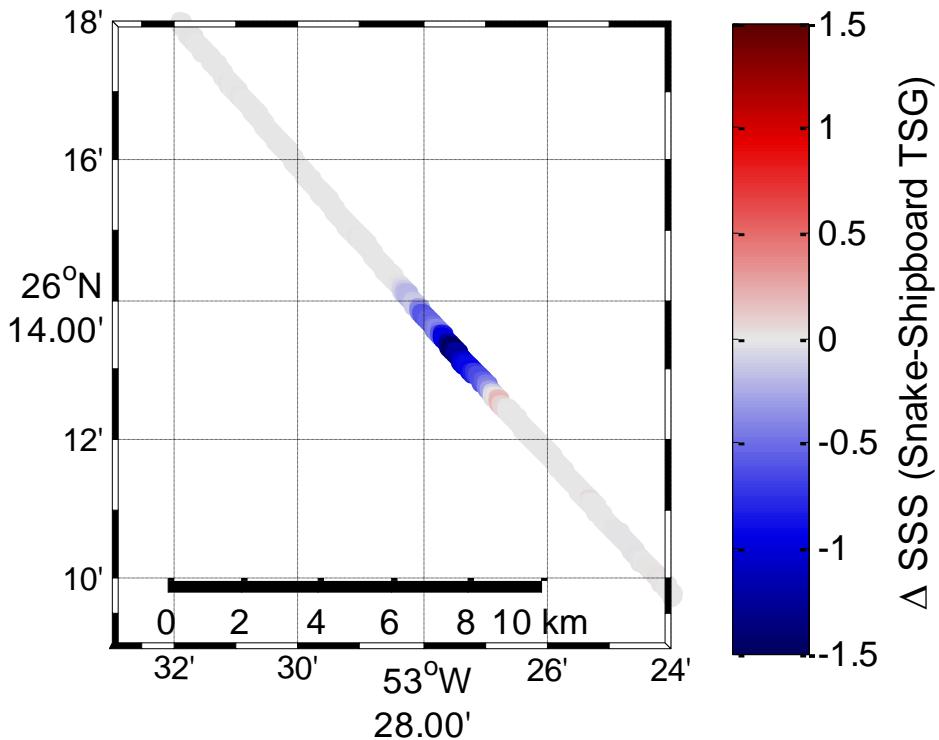
- Second SSS enhancement event shown (black)
- $\Delta SST$  (0-5m) shown in red
- Time in UTC, local time in blue
- ~100 km along track shown





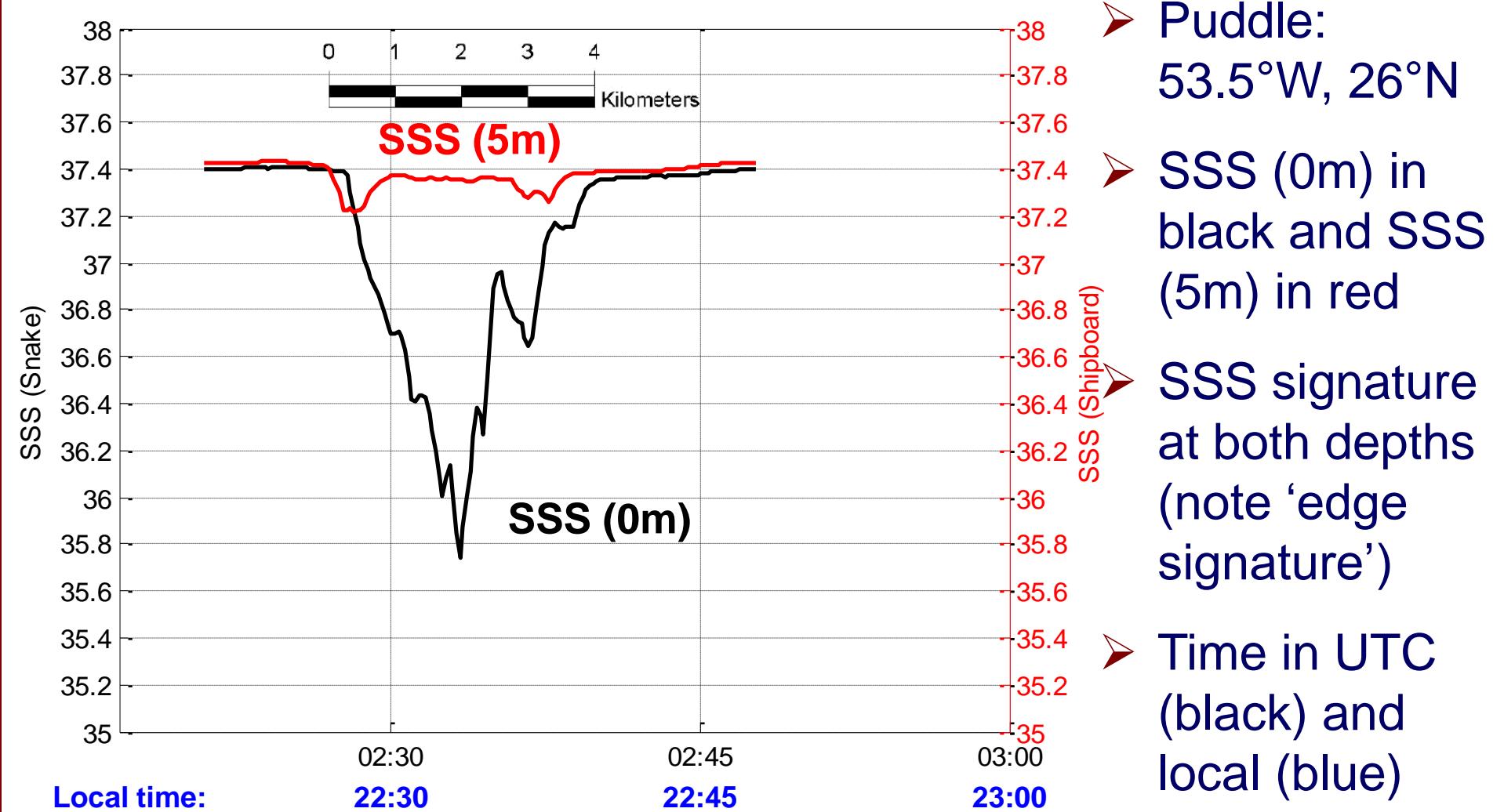
- No major enhancements throughout the cruise
- Only one event with an enhancement around 1°C
- Diurnal signal still visible on most days

# Results: SPURS 3 (October 2013)

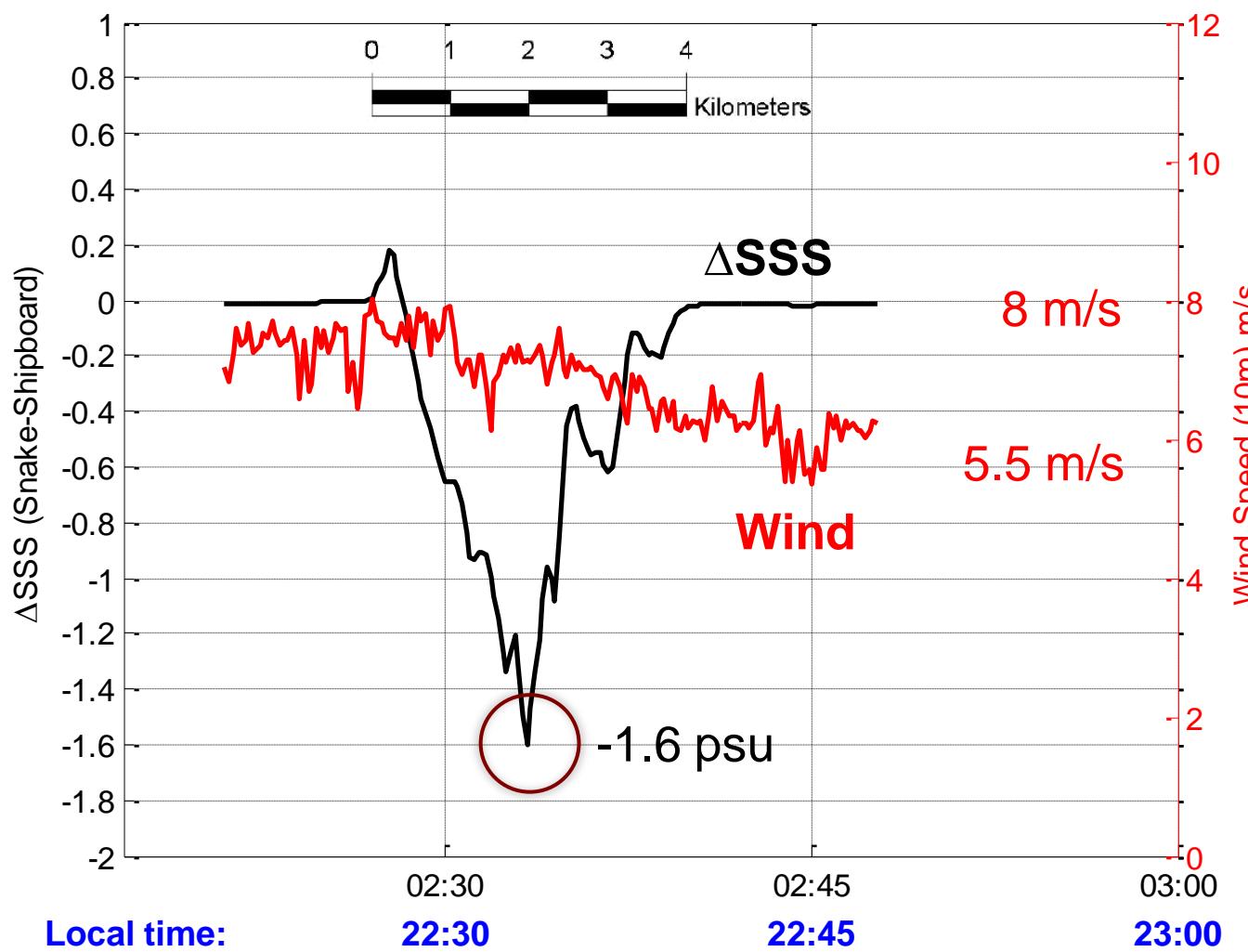


- A puddle around  $53.5^{\circ}\text{W}$ ,  $26^{\circ}\text{N}$ , ship track shown with  $\Delta \text{SSS}$  (left) and  $\Delta \text{SST}$  (right)
- Puddle is  $\sim 4\text{km}$  across, negative signature in SSS and SST

# Results: SPURS 3 (October 2013)



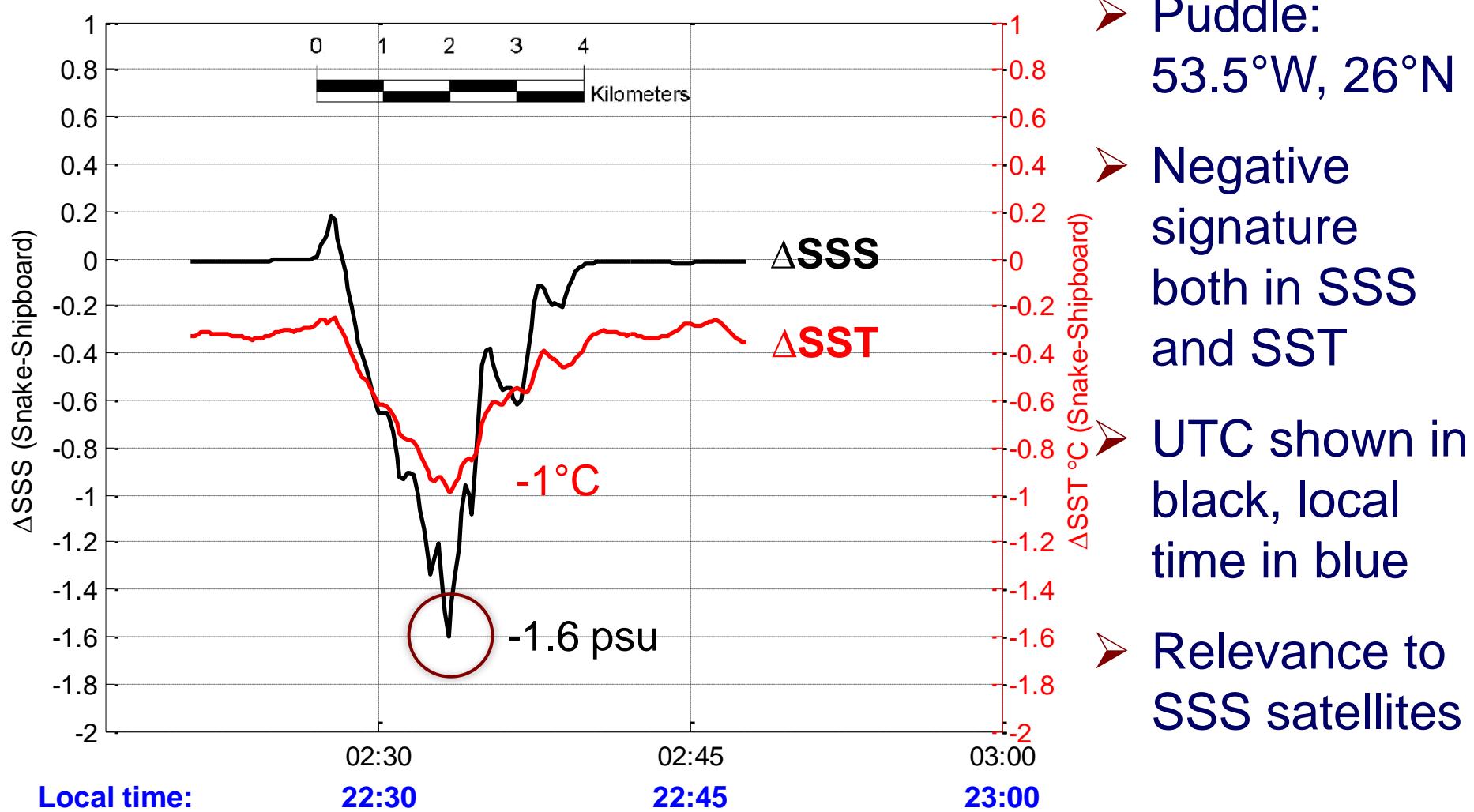
# Results: SPURS 3 (October 2013)



- Puddle: 53.5°W, 26°N
- Difference in SSS (0m-5m) and wind shown
- Time in UTC (black), local time in blue
- Relevance to SSS satellites



# Results: SPURS 3 (October 2013)



# Conclusions

- Surface salinity enhancements: 2 events observed in stable boundary layer (SBL) conditions during March 2013 cruise
- Unlike SBL events, puddles can occur at any time of day, and they are likely to affect Aquarius/SMOS retrievals. Signal exceeding -1.5 psu observed during September 2013 cruise
- Next steps:
  - Model the development and breakdown of surface T/S changes and hence SBL (Price-Weller-Pinkel model)
  - Gather more data in puddles (Transpacific rowboat [May/June 2014, May-August 2015], Fresh SPURS?)
  - Estimate impacts on Aquarius/SMOS calibration/validation

